Research Article

Economic Performance of Different Concentrations of Probiotics on Broiler Chickens

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Abstract | Broiler production is the most intensive branch of animal husbandry. This reproduction method is relatively quick, which allows for faster turnover of the resources involved. Recent addition of Probiotics with broilers feed shows good efficacy to improve its production. So this expermintal study aimed to examine the influence of the addition of probiotics in broiler diets on the economic outcomes of production. Total 120 broiler chicks were divided into three groups of fourty birds each (C, L, & H) fed with diverse concentrations of Probiotics. After the first week of treatment, the two groups (L and H) displayed a probiotics effect that manifested as a significant increase in body weight (BW) than the control group. After 28 days of treatment, the effect of high levels of probiotics (group H) demonstrated a significant increase of group (H) and either group (L) and control; meanwhile, both treated groups (L and H) exhibited a significant increase in feed intake (FI) compared with the control group. At the end of the 42-day study period, the data showed a significant increase in BW and FI in group H compared with both group L and the control group. Finally, the results found that the two groups L and H showed a significant increase in the most productive performance parameters at the most periods time. The results also endly indicated that the 1 g/kg dose (0.5 concentration) of probiotics provided for group H was better than the low concentration of probiotics provided for group L (0.25 concentration). The study concluded that extention of the investigated probiotic (*L. delbrueckii*) to broiler feed can plays an important role in improving the economic and productive efficiency of poultry farms, even though it represents only a small part of the total or variable cost of the production of poultry.

Keywords | Probiotics, Economic, Performance, Production, Broiler

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INTRODUCTION

Animal feed can be very expensive in livestock production, particularly in poultry production (up to 75%–80% of total costs). Accordingly, in recent years, the use of feed-added substances to increase feed proficiency and reduced costs has been examined (Araujo et al., 2019). Feed-added substances are non-nutritive aggravates that are added to livestock rations to improve the proficiency of feed usage and feed acceptance (Singh et al., 2021).

It is critical for the exceptionally important broiler production division to accomplish the production goals and limit financial misfortunes by guaranteeing the security of broiler meat through controlling and eliminating foodborne microorganisms (Mountzouris et al., 2010).

Probiotics can be utilized to supplant antibiotics because they are dietary enhancements composed of live and non-pathogenic microbial operators that have the advantage of improving wellbeing through intestinal parity (Ayasan, 2013).

Probiotics are singular microorganisms or groups of microorganisms that improve the qualities of the intestinal microflora. Their impact is reflected in the decrease of harm from diseases; they also improve the capacity of the safe production and have a huge effect on the morpho-practical attributes of digestive organs (Okanović et al., 2014). These effects help improve broiler development feed transformation and lead to decreased mortality (Yang, Iji and Choct 2009).

Probiotics gainfully influence the host animal by improving its intestinal parity. They establish gut conditions that stifle destructive microorganisms and favor useful ones, reduce the risk of disease, boost immune function, and increase protection from contamination. In addition to maintaining health, probiotics have been shown to improve the growth performance of poultry (Okanović et al., 2013).

Probiotics are noted for their ability to improve the physical performance of birds, for example, by increasing body weight (BW) and body weight gain (BWG) and by improving feed transformation proportions. Furthermore, they play a significant role in improving the productivity and economic efficiency of poultry farms (Rehman et al., 2020).

A specialist board authorized by the Food and Agriculture Organization (FAO /WHO 2001) characterized probiotics as "live microorganisms" that when regulated in sufficient sums present a medical advantage on the host, improve development loadsof growth, consequently improve economic efficiency.

Ignatova (Ignatova et al., 2009) noted that probiotics dramatically influence BW ($p < 0.001$), feed intake (FI), and the feed conversion pace of chickens compared with the control group. Probiotics maintain gut health and reduce pathogenic microorganisms and therefore reduce the occurrence of diseases in the poultry themselves (Kampf 2012).

Hence, the point of this study was to determine the impact of added probiotics on the economic aspects of broiler production.

This experiment intended to evaluate the impact of dietary supplementation with probiotics (*Lactobacillus delbrueckii*) (Probax®) on the economic and productive efficiency of broilers.

MATERIALS AND METHODS

Probiotic

The probiotic *L. delbrueckii* was used in this study (CLOSTAT™, Kemin, Europe, NV. Herentals, Belgium).

Animals and housing

A total of 120 1-day-old male broiler chicks with comparable normal BW (Ross 708 strain; Mangabad, Assiut, Egypt) were weighed and assigned to 12 floor pens (10 feathered creatures were placed in each 100 × 100 cm floor pen) in a situation-controlled room at the Animal and Poultry Behavior and Management Research Unit, the Faculty of Veterinary Medicine, Assiut University, Egypt. New and dry wood shavings were included at a depth of 10 cm. The rules of Aviagen (Aviagen, 2018) were followed when caring for the broilers.

All procedures and animal handling were approved by the Animal Care and Use Committee of the Faculty of Veterinary Medicine, Assiut University, Egypt.

Dietary treatments

A total number of 120 broilers were used in this study, Broilers are divided into three groups of 40 birds each, housed in 12 floor pens of 10 broilers for every imitate: a normal eating regimen combined with a probiotic concentration of 0 (control), 0.25 (0.25×), and 0.5 (0.5×) g/kg feed, corresponding to groups C, L, and H, respectively. The inclusion of CLOSTATTM dietary medicines depended on the organization's suggestion, and the dietary treatment time frame lasted from day 1 to day 35, when we arrived at the market weight. The dietary nourishment was provided previously (Mohammed et al., 2018).

Estimation of productive performance

a. Body weight: The chicks were weighed weekly.
b. Feed intake: FI was estimated by regularly providing a known amount of rations at 10:00 AM; at the end of the week, the remaining portion of feed was weighed. From this value, the average daily FI was estimated.
c. Weight gain: Estimated by the differences between two successive weights.
d. Feed conversion: Estimated by dividing the FI/g/bird by weight gain/g/bird according to Wagner (Wagner et al., 1983).

$$FCR = \frac{FI\ (g)/bird/week}{BWG\ (g)/bird/week}$$

e. Total feed cost: Estimated by multiplying the total FI/g/bird*cost of the rations in kg plus multiplying by the result of the total FI/g/bird*cost of probiotics/g according to (Wagner et al., 1983).

Statistical analysis

The statistical analyses were performed using SPSS software package version 16.0. The data were analyzed using a one-way analysis of variance (ANOVA) followed by a

Table 1: Effect of probiotics on productive items of broilers after 7 days

	No.	BW	FI	Feed efficiency	Total feed cost
Control	40	0.16 ± 0.002[a]	0.09 ± 0.002[a]	1.8 ± 0.02[a]	0.55484[a]
L	40	0.18 ± 0.002[b]	0.1 ± 0.00002[b]	1.9 ± 0.02[a]	0.691566[b]
H	40	0.19 ± 0.003[c]	0.09 ± 0.0001[a]	2.03 ± 0.04[b]	0.666697[b]

Table 2: Effect of probiotics on productive items of broilers after 28 days

Group	No.	Average BW	Average FI	Average BWG	Feed efficiency	Feed cost
C	40	1.47125 ± 0.03[a]	1.475575 ± 0.02[a]	1.314583 ± 0.03[a]	0.89 ± 0.02[a]	9.44368[a]
L	40	1.53125 ± 0.02[a]	1.548093**±0.01[b]	1.354583 ± 0.02[a]	0.88 ± 0.01[a]	11.32319[a]
H	40	1.53625*±0.01[b]	1.584114**±0.01[b]	1.352917 ± 0.01[a]	0.85 ± 0.01[a]	11.58666[a]

Table 3: Effect of probiotics on productive items of broilers after 42 days

Group	No.	Average BW	Average FI	Average BWG	Feed efficiency	Feed cost
C	40	3.49625 ± 0.65[a]	3.0765 ± 29.3[a]	3.21 ± 0.07[a]	1.085514 ± 0.026[a]	19.6896[a]
L	40	3.52125 ± 0.39[a]	3.099125 ± 18.4[a]	3.34 ± 0.03[b]	1.079202 ± 0.011[a]	22.66789[b]
H	40	3.725* ± 0.37[b]	3.1625* ± 13.96[b]	3.48 ± 0.02[c]	1.119895 ± 0.014[a]	23.13143[b]

post-hoc lowest significant difference multiple range test for comparisons between the control and experiment groups. All data were represented as the mean ± SE for all experimental and control animals ($p < 0.05$).

To determine whether there was a significant relationship between BWG and FI of the three different groups at the end of the experiment, the data were analyzed using a regression analysis and an ANOVA (SAS 2002).

RESULTS

The results after seven days of treatment are presented in Table 1. There was a significant increase ($p < 0.05$) in BW for all groups compared with the baseline, although FI only displayed a significant increase in L group compared with the control group ($p < 0.05$). Feed efficiency displayed a significant increase in the H group ($p < 0.05$) compared with both L and control groups; moreover, there was a significant increase in the feed cost ($p < 0.05$) between both L and H groups and the control group.

Table 2 showed that there was a significant increase ($p < 0.05$) in BW after 28 days between group H and control group, in the meantime, FI results exhibited a significant increase ($p < 0.05$) between the control and either L and H groups. There were no significant differences between the three groups for BWG, feed efficiency, or cost.

The results in Table 3 showed only significant increases ($p < 0.05$) in the final BW and FI after 42 days of the treated group (H) only, compare with the pair groups (L) and control. The control group had the lowest BW. The final BWG results displayed a significant increase ($p < 0.05$) of the treated groups (H and L) among the three groups. Feed efficiency did not differ significantly between the groups; however, feed cost increased significantly between both the L and H treated groups and the control group.

Figure 1 shows the regression between BWG and FI in the control group. The coefficient of determination (R^2) from this analysis indicates that the responsibility ratio of the independent factor (FI) associated with changes in the dependent factor (BWG) was 6%, which means there was a weak effect of the independent factor (FI) on the dependent factor (BWG).

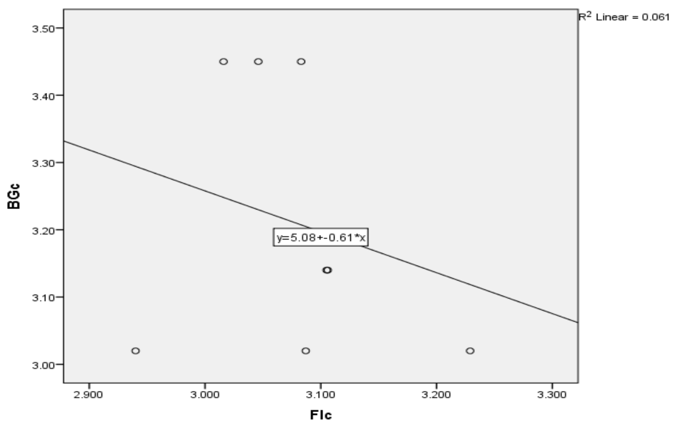

Figure 1: Regression analysis between body weight gain and feed intake in the control group

Figure 2 shows the regression between BWG and FI in the L group. R^2 from this analysis indicates that the responsibility ratio of the independent factor (FI) associated with changes in the dependent factor (BWG) was 6%, which means there was a weak effect of the independent factor (FI) on the dependent factor (BWG).

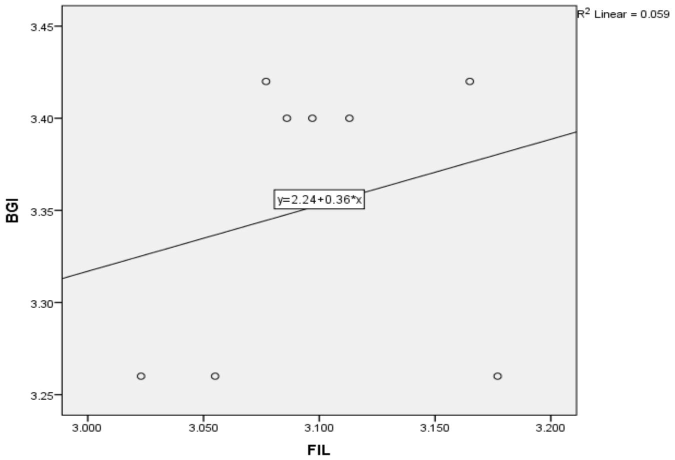

Figure 2: Regression analysis between body weight gain and feed intake in the low probiotic group

Figure 3 shows the regression between BWG and FI in the H group. R^2 from this analysis indicates that the responsibility ratio of the independent factor (FI) associated with changes in the dependent factor (BWG) was 10%, which means there was a positive effect of the independent factor (FI) on the dependent factor (BWG).

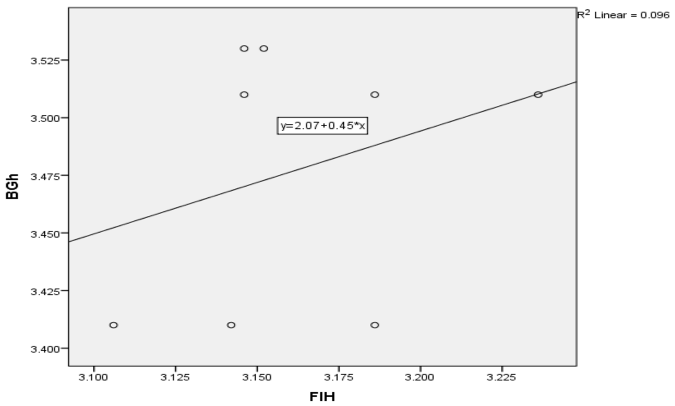

Figure 3: Regression analysis between body weight gain and feed intake in the high probiotic group

DISCUSSION

One of the goals of the present study was to clarify the effects of dietary supplementation with probiotics and their different concentrations on growth. After the first week, a probiotics effect appeared in the two treated groups (L and H), which was displayed as a significant increase in BW than the control group, with that the L group showing the highest significant FI. This disagreed with the results of. Mohamed et al. (2014), who found that during the first week of treatment, the control group did not differ significantly from the two probiotics-treated groups. Similarly, another study observed that feed intake didn't changed by the additon of probiotics (Sohail et al., 2012). Otherwise, Hamasalim (2016), certained such the extention of probiotic, caused a harmonious of GIT microbiota which is necessary for the intial growth of the intestine which leads to superior feed intake in broilers throughout the begning phase.

Conversely, after 28 days, the effect of high levels of probiotics (group H) demonstrated a significant increase of BW in group H compared with group L and the control group; meanwhile, both treated groups (L and H) exhibited a significant increase in FI compared with the control group. These results were aligned with Abdel-Raheem and Abd-Allah, (2011), stated that the extention by probiotics shorted the time of stomch emptying, which leads to superior feed intake. Also these findings might be a result of the probiotics action on the intestinal microflora, which improve the digestibility and absorbability and take advantage of different supplements in the gastro intestinal tract (Yu et al., 2022). Dietary probiotics intiate the growth of valuable bacteria by yielding various metabolites and thus meliorate the gut microecological atmosphere and the activity of outward chemicals on redressing digestibility of the supplements and diminishing of phosphorous and nitrogen (Attia et al., 2013; Sun et al., 2019; Robinson et al., 2020).

The data presented after 42 days showed significant increases in BW and FI between group H compared with both group L and the control group. These end results in straight with Sohail et al., 2012 who fixed that the weight gain was enlarged with eleveted levels of probiotics. Similarly (Waititu et al., 2014; Qorbanpour et al., 2018; Jha et al., 2020); declared that addition of probiotics cause significantly increase of BW, BWG and feed efficiency in broilers.

Abetterment in weight gain might be related with such dietary probiotics have been introduced to preserve the balance of the intestinal flora of animals, prevent digestive tract diseases, improve feed digestibility, contribute to increased nutrient use, and cause better zootechnical output in animals (Rehman et al., 2020).

These findings agree with those of Rehman et al. (2020), Kannan et al. (2017), and Kalavathy et al. (2008); who found that normal BW was improved in the group that was fed a supplemented diet with probiotics compared with that of the control group. Moreover, these discoveries are similar to those obtained by Nayebpor et al. (2007), who found that feeding broiler chickens bolstered microbial probiotics significantly ($p < 0.05$) increased their BW. The probiotic (*L. acidophilus*)-treated groups in both Ross and Hubbard Cobb given the most elevated income in net benefit compared with Cobb. This was a result of the increases in BW, BWG, and feed conversion ratio and the reduction in the mortality rate.

These findings are supported by other results showing that broiler chicks fed the control diet supplemented with yeast and probiotic-containing bacteria (BioGaurd) significantly increased weight gain weekly, during the second week, and during all weeks of the experiment until the last week, in which the final weight gain was significantly higher in the BioGaurd-fed broilers (Mohamed et al., 2014). However, our results disagreed with those of Mohamed et al. 2014 because the probiotics feeding within each level significantly affected weight gain during the first week in our study. But, although the addition of probiotics to the feed rations did not result in significant differences between the three groups in weight gain at the middle of the experiment (28 days), the final total weight gain was significantly higher in both probiotics-treated groups (L and H) compared with the control group. Meanwhile, the H group displayed the highest BWG compared with the other treated group.

The feed cost for the production of the group H broilers was significantly higher (23.13 L.E/bird) than that of the control group (19.69 L.E/bird). The feed cost of group L (22.67 L.E/bird) was also significantly higher than the control group. Moreover, the benefit of the group H broilers was better than that of group L because the total return per average weight of the chick was significantly higher in group H (3.725* ± 0.37 vs. 3.52125 ± 0.39, respectively). This finding agrees with those of Santin et al. (Santin et al., 2001) and Panda (Panda et al., 2006) who found significant increases ($p < 0.05$) in the net income value of groups supplemented with probiotics compared with the control groups; thus, the probiotics improved the financial proficiency of broiler production.

The obtained results showed that although the feed additives significantly increased the total feed cost compared with the control group, the H group had a higher total return (3.48 ± 0.02) compared with the L group (3.34 ± 0.03), and both were better than the control group (3.21 ± 0.07). This agrees with the findings of Seifi (2013) who discovered that during the first and second weeks, feeding commercial broiler ration; feed conversion ratio was better in Arbor acres broilers. With regard to the effect of probiotics, the control group did not differ significantly from the two treated groups during the first week, while the use of yeast and probiotics-containing bacteria (BioGaurd) improved the overall feed conversion ratio (1.69 ± 0.03) compared with the bacterial probiotic plus enzyme mixture (Micro-BACLA) (1.78 ± 0.01) and the control group (1.79 ± 0.01). This result could be attributed to the action of microbial floras on the alimentary tract, which have considerable effects on the health and performance of boiler chickens (Wang Yanbo and Qing Gu 2010; Alkhalf, Alhaj and Al-homidan 2010).The addition of a low level of probiotics did not have a significant effect on BW after 28 days or at the end of the experiment after 42 days. Conversely, the addition of a high level of probiotics increased BW after 28 days and at the end of the experiment.

Using two concentrations of probiotics as feed additives resulted in a nearly significant increase of BW and BWG in the high concentration group compared with the low concentration group at the end of the experiment. The results showed that each treated group had a significantly increased total feed cost compared with the control group. However, the increase in the total cost was compensated by a significantly higher increase in the total return. This result agreed with those of (Panda et al., 2006) and (Bonsu et al., 2012) who found that using probiotics in broiler chickens led to increased economic profit margins due to their positive effect on performance.

There was a weak effect of the independent factor (FI) on the dependent factor (BWG) in the C and L groups (Figs. 1 and 2).

There was a positive relationship between BWG and FI in the H group; furthermore, the largest regression and the highest R^2 appeared in the H group results (Figure 3), which indicates that the increase in the percentage of high probiotics level (group H) resulted in an increase in liability percentage of probiotic for changes in the event (the effect of the independent factor (FI) on the dependent factor (BWG)).

We measured the effect of two different concentrations of probiotics on meat yield in broiler chickens and found that when probiotics were added at a concentration of 0.25, meat yield increased at an insignificant rate, but when added at a concentration of 0.5, it increased at a significant rate.

In terms of the total variable cost (feed cost), compared with the control group, there was an increase in the cost and in the meat yield for the two treated groups (L and H) at rates of 3.34 ± 0.03 and 3.48 ± 0.02, respectively. The highest concentration treated group (H) had the highest meat yield (3.48 ± 0.02), which exceeds the rate of increase in cost (23.13). According to the poultry stock, the price of broilers in kg at that time was 24 LE/kg, indicating a value increase of approximately 83 L.E, which reflects the increased economic feasibility from adding probiotics at a higher concentration compared with a low concentration.

CONCLUSION

This study suggests that using a probiotic feed additive (*L. delbrueckii*) at high concentrations can significantly improve the economic and productive efficiency of poultry farm although it constitute small cost from the variable costs of poultry output.

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CONFLICT OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

NOVELTY STATEMENT

Economic view of broiler breeding with different supplement of probiotics.

AUTHORS CONTRIBUTION

Ahmed A. Mohammed: Conceptualization, Methodology. Ayman S. Abdel- Maguid: Data curation, Analysis, Software, Writing. Eman A A Negm : Reviewing. Madeh HA Darwish : Supervision.

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